REMARKS

This paper is presented in response to the final official action dated January 13, 2011, and is timely filed with a petition for extension of time and a Request for Continued Examination.

Claim Amendments

Claim 1 is amended herein to show the underlining inadvertently omitted from the prior amendment, and to include the alternative that the reaction of the layer structure is carried out in vapor of the reaction element sulfur and/or selenium. Support is found in the original specification at page 4, line 7. The option that the reaction of the layer structure is carried out at atmospheric pressure or at a pressure lower than atmospheric pressure is now presented as dependent claim 42, support being found in the original specification at page 12, lines 21-25, for example.

Claim 4 is amended to recite that each of the layers is applied by a PVD and/or CVD method, support being found in original claim 4.

Claims 5, 11, and 19 are amended to improve clarity.

Claim 6 is amended to correct a typographical error.

Claim 10 is amended to omit reference to the back layer comprising molybdenum, and this option is now recited in new claim 43, support being found in original claim 2, for example.

Claims 1-41 are now pending. Claims 1-20 and 41 are under examination, and claims 21-40 have been withdrawn. Claims 1 and 10 are independent.

Claim Objections

Claim 1 now shows underlining of the claim element added in the previous amendment.

Claim Rejections – 35 USC 103

Claims 1-5 and 7-9 were rejected as obvious in view of the four-way combination of Nakata EP 0940860, Gay U.S. Patent No. 4,638,111, Probst U.S. Patent No. 5,626,688, and Kim "Effect of selenization pressure on CuInSe2 thin films selenized using co-sputtered Cu-In precursors."

Claim 6 was rejected as obvious in view of the combination of Nakata, Probst, and Menezes U.S. Patent Application Publication No. 2003/0230338. "as applied to claim1 above" and further in view of Menezes.

Claims 10-17 and 20 were rejected as obvious in view of the combination of Nakata and Probst.

Claims 18 and 19 were rejected as obvious in view of the combination of Nakata, Probst, and Gay.

Claim 41 was rejected as obvious in view of the combination of Nakata, Gay, Kim, and Probst.

The rejections are moot in view of the claim amendments presented herein, or are traversed.

Regarding the spherical or grain-shaped semiconductor elements, the official action relies on substitution of materials of Nakata with those of Probst to arrive at a spherical solar cell with a Mo back contact layer.

Claim 1 has been amended to specify (a) that the substrate core comprises soda-lime glass; (b) that the conductive back contact layer is applied directly on to the core; (c) that the conductive back contact layer comprises one or more conductive materials selected from the group consisting of molybdenum, molybdenum-gallium, tungsten, vanadium, transparent conductive oxide (TCO), a polymer having conductive particles, an intrinsic conductive polymer, and that the conductive back contact layer optionally further comprises a gallium layer over the conductive material; and (d) that the first precursor layer comprising copper or copper gallium is applied to the conductive back contact layer.

Likewise, claim 10 requires a core comprising soda-lime glass, and has been amended to specify that the core is directly coated at least with one back contact layer comprising one or more conductive materials selected from the group consisting of molybdenum, molybdenum-gallium, tungsten, vanadium, transparent conductive oxide (TCO), a polymer having conductive particles, an intrinsic conductive polymer, and that the conductive back contact layer optionally further comprises a gallium layer over the conductive material.

The applicants submit that Probst does not provide motivation to substitute use of soda-lime glass for a spherical substrate core instead of the materials specifically taught by Nakata. Such a combination is only motivated by the teachings of the present inventors. The official action alleges a motivation based on selection of known materials based on suitability for an intended use (citing MPEP 2144). However, there has been no showing that suitability of glass for spherical substrate cores in the invention of Nakata was recognized in the prior art (see MPEP 2144.07 – the suitability for an intended purpose must be "art recognized").

Starting from the spherical solar cells of Nakata, which comprise a metal core 21 as substrate (see [0074]), one would accordingly surely not consider dismissing the metal core and using a glass core, since without a barrier layer one would expect reliability issues and with a barrier layer one could not expect any significant effect of

this substrate change (the effect in Probst comes from the further addition of a dosed amount of alkali ions).

Moreover, one has also to keep in mind that changing the substrate may obviously lead to adhesion problems with layers deposited on this substrate. In this respect, Probst already discloses that glass as a substrate and a molybdenum back contact may lead to adhesion problems of the CIS layer even when using flat glass panes as a substrate. See column 2, lines 4-6 ("It should be cited as a further disadvantage that the chalcopyrite layers often have poor adhesion on the molybdenum back electrode.)

One skilled in the art would thus surely be aware of these possible adhesion related problems.

Moreover, one would expect the adhesion problems to get worse when little spheres are used as a substrate because of their very high curvature (which may lead to stress/tensions in the layers and may further lower adhesion).

Thus, it cannot be said that substitution of molybdenum-coated glass for a spherical substrate core in place of the metal cores of Nakata was recognized in the prior art as suitable. With this failure of teaching or recognition in the prior art, there is no basis for *prima facie* obviousness.

Nevertheless, if Nakata were modified in view of Probst, the skilled artisan would not arrive at the structure thus claimed, but rather one in which a diffusion barrier layer is included. See Probst at column 3, lines 56-60:

> Given employment of an alkali-containing substrate, particularly of a glass substrate, additional alkali diffusion from the substrate into the absorber layer during the manufacture thereof is prevented in accordance with this invention by a diffusion barrier layer. Thin layers of silicon nitride, titanium

Nakata also requires use of a diffusion barrier layer, for example a silicon nitride film. See, column 9, lines 20-25:

> formed by low pressure CVD method. The reflective film 2, comprising these two insulating coatings, reflect and disperse incident light. It also prevents impurities contained in core 1 from diffusing and being mixed with the high purity silicon of semiconductor thin film layer which is formed on top of reflective film 2. The minute irregu-

See also column 20, lines 15-16 ("Silicon nitride film 32 prevents the diffusion of impurities from core 31"), column 21, lines 37-38 (silicon nitride film 212), and column 23, lines 17-18 (silicon nitride film 242).

Thus, when the art is combined in an objective way, motivated only by teachings in the prior art, the skilled artisan would arrive at a structure outside the scope of the current claims.

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Glass is used in the present invention because the inventors have surprisingly found that sodium coming from the glass in fact reliably helps forming especially good CIS layers in this special case when using spherical or grain-shaped substrate cores. The inventors have found that using glass substrate as claimed surprisingly allows to provide the right amount of sodium using the substrate. It is the special form of the substrate which thus reliably allows to provide the right amount of sodium. This is contrary to the teachings regarding us of sodium lime glass in the planar form of substrate disparaged in Probst and thus modified in Probst by inclusion of a diffusion barrier layer and dosed addition of an alkali metal into the chalcopyrite absorber layer. See column 2, lines 21-31. Use of a diffusion barrier layer is excluded from the claimed invention, and thus the proposed combination of the prior art would not lead to the claimed invention.

Conclusion

For all the foregoing reasons, claims 1-20 and 41 are of proper form and scope for allowance, and such action is solicited.

Should the examiner wish to discuss the foregoing or any matter of form in an effort to advance this application toward allowance, she is urged to telephone the undersigned at the indicated number.

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Respectfully submitted,

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